

New Approach for the Integrated Aquaculture Management from the View Point of Multi-functional Roles of Fisheries and Aquacultures

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**The 33rd UJNR Aquaculture Panel Symposium
(Nagasaki, Nov. 2-3, 2004)**

Multi-functional role of fisheries (Matsuda, 2001)

1. A major role widely accepted: Food supply

2. Another possible roles:

- **Conservation of habitat environment**
- **Monitoring of environment and resources**
- **Recovery of inflowing nutrients (N and P) through fish catch and harvesting**
- **Reduction of COD value through biological activities (purification)**
- **Environmental watching by fisherman**
- **Environmental education, eco-tourism**

International Symposium on Multiple Roles and Functions of Fisheries and Fisheries Communities

(Feb. 2003, Aomori, Japan)

- **Key note speech by Prof. Katsuji Hiroyoshi:**

“There has not been awareness among people regarding multiple functions of fisheries communities. There is a need to renew our recognition in this respect from the viewpoint of structural changes in fisheries as well as the earth’s environment.”

New policy (FY 2004 -)

by the Ministry of Agriculture, Forestry and Fisheries, Japan

**Main concept: more environmental conservation
concerned agriculture, forestry and fisheries**

**Major goal: to establish sustainable society through multi-
functional roles of agriculture, forestry and fisheries
through**

- 1. Healthy water circulation**
- 2. Healthy atmospheric circulation**
- 3. Healthy material circulation**
- 4. Conservation of healthy local communities**

Special Report by Science Council of Japan

submitted to the Minister of Agriculture, Forestry and Fisheries (Aug. 2004)

Multiple roles and functions of fisheries and fishing communities:

- **Role of food supply**
- **Role on environmental conservation**
- **Role on formation of regional community**
- **Role on people's security**
- **Role on providing fields of education and many kinds of amenity**

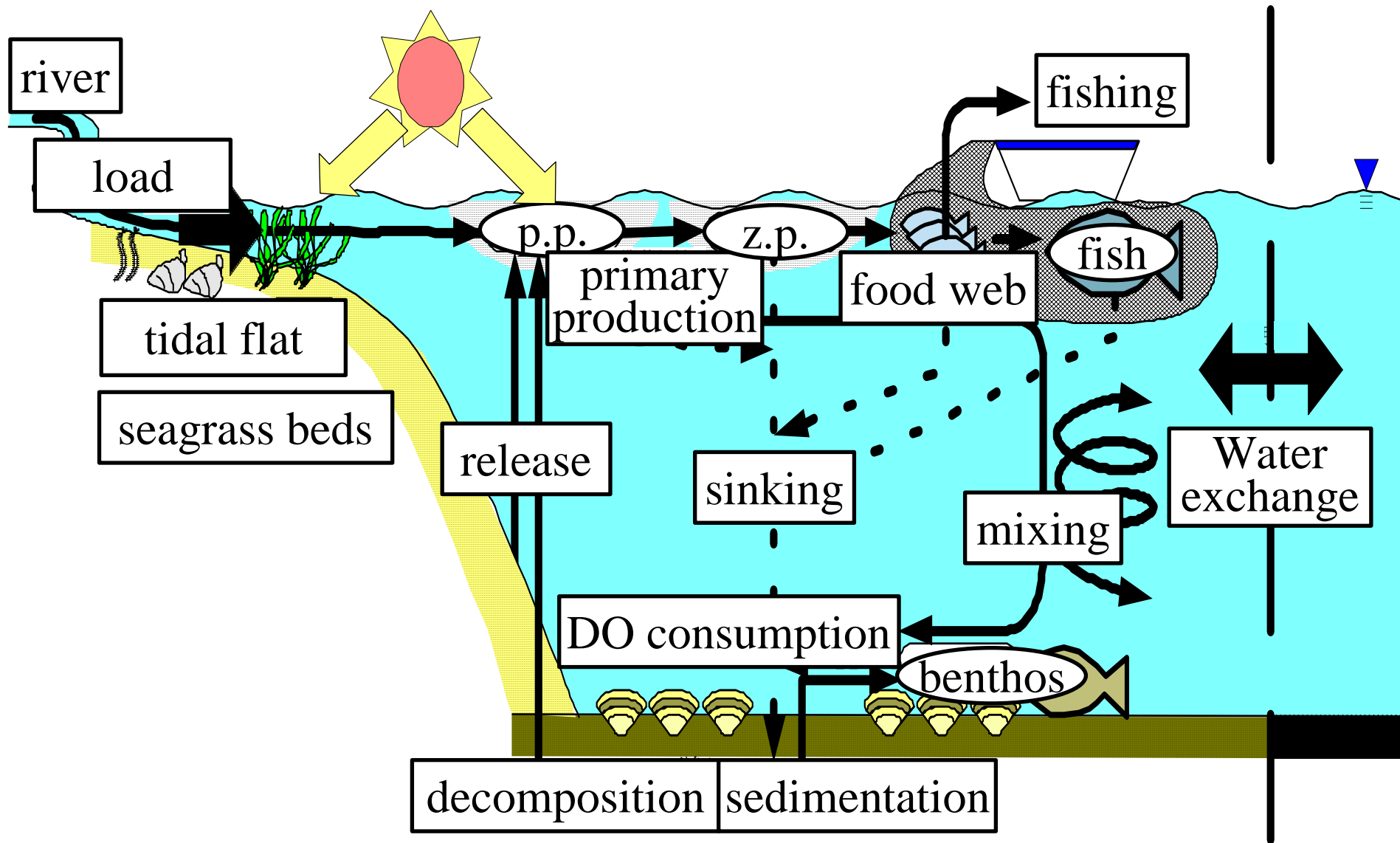
Five selected multi-functional roles of fisheries and aquaculture

- ① Material cycling between land and sea**
- ② Monitoring of environment and living resources**
- ③ Purification of polluted environment through biological activities and process of food chain**
- ④ Environmental watching by fisherman**
- ⑤ Environmental education**

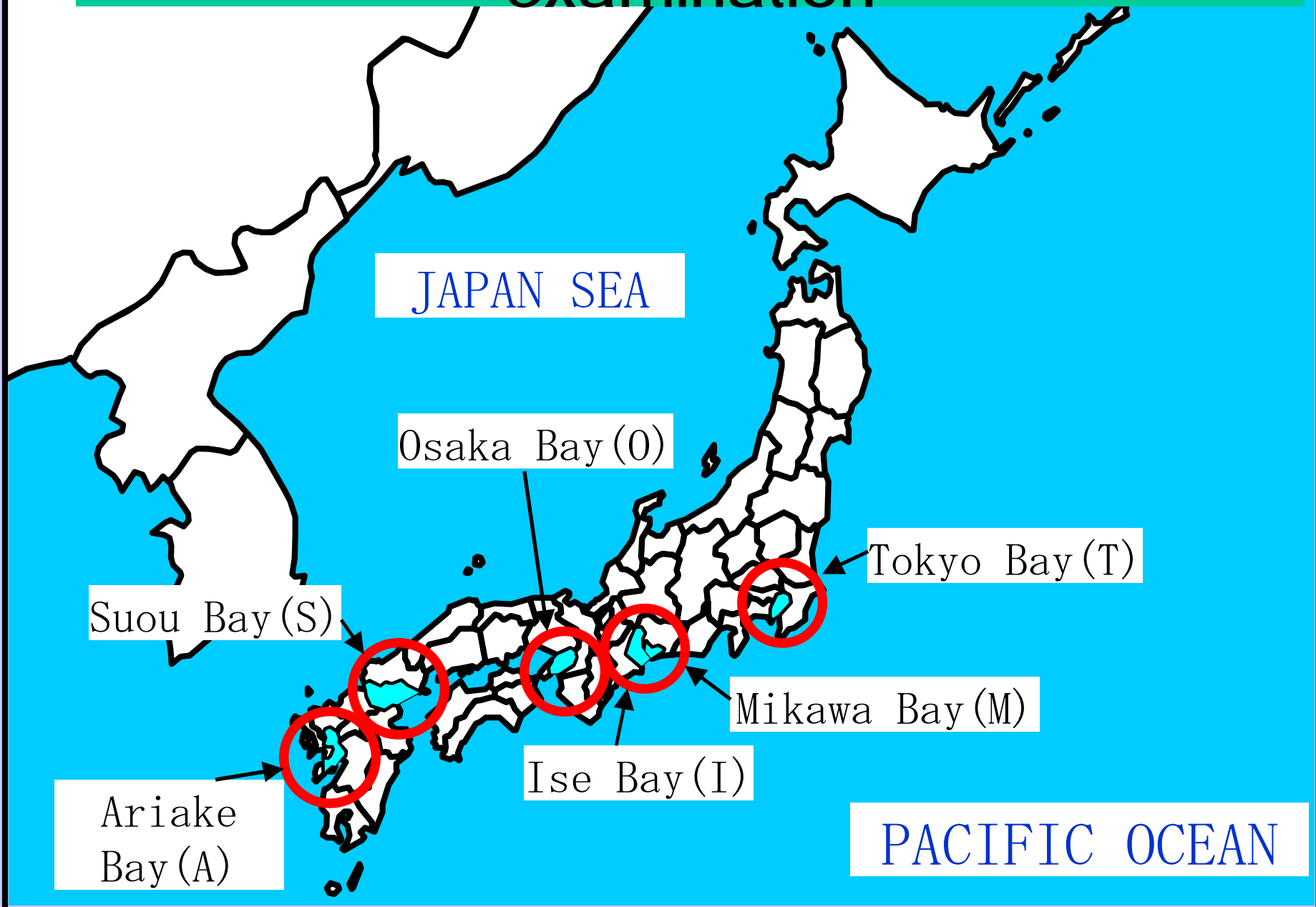
① Material cycling between land and sea

- Landing of fish catch is a valuable process by which inflowing N and P are recycled to the land.
- Non feeding aquaculture such as bivalve culture and algal culture also contributes to the same process.
- Anadromous fishes such as salmon play a same role on the material cycling.

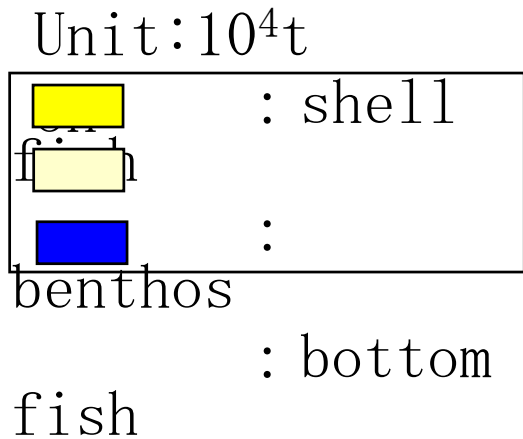
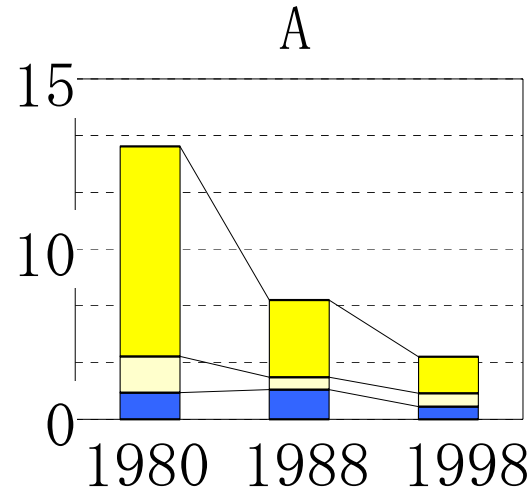
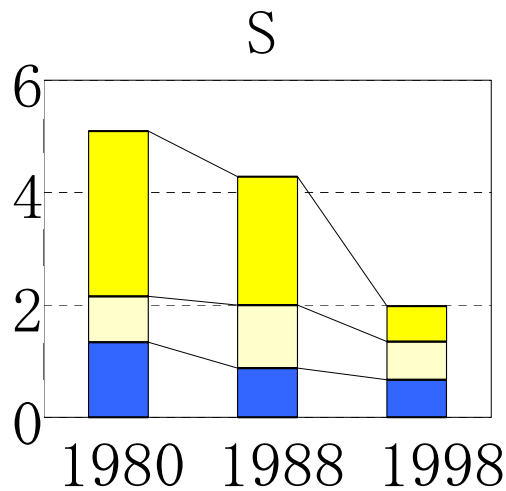
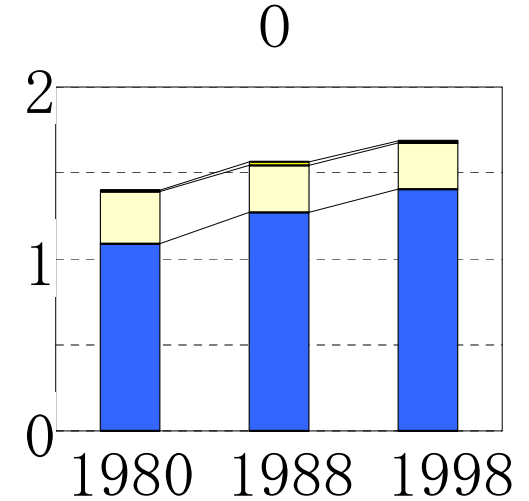
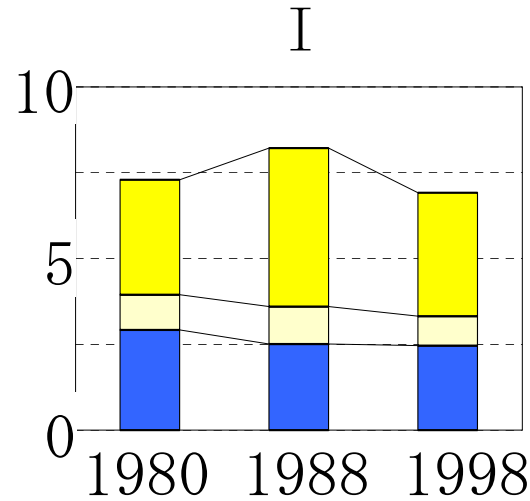
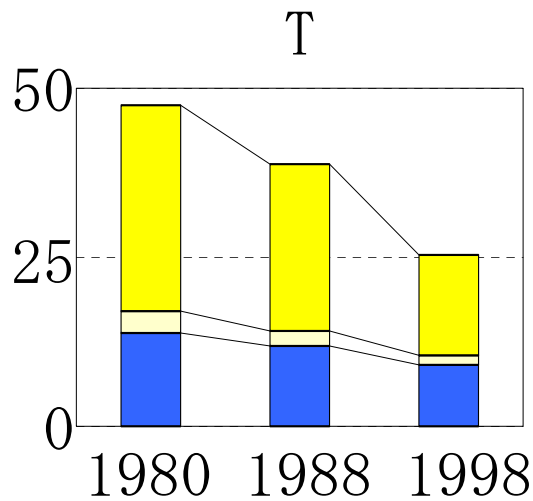
Structure of the ecosystem and material circulation



Case study for the preliminary examination



"Removing" benthic fish catch





***Porphyra* (Nori, laver) culture removes N and P from marine environment**

Recovery of inflowing N and P by fisheries in Seto Inland Sea

Year	Recovery (%)	
	Nitrogen	Phosphorus
1979	6.52	15.16
1984	7.66	22.45
1989	6.32	20.49
1994	4.67	16.34
1999	4.99	15.53

Recovery(%):(Fish catch+Laver+Oyster)/Load x 100

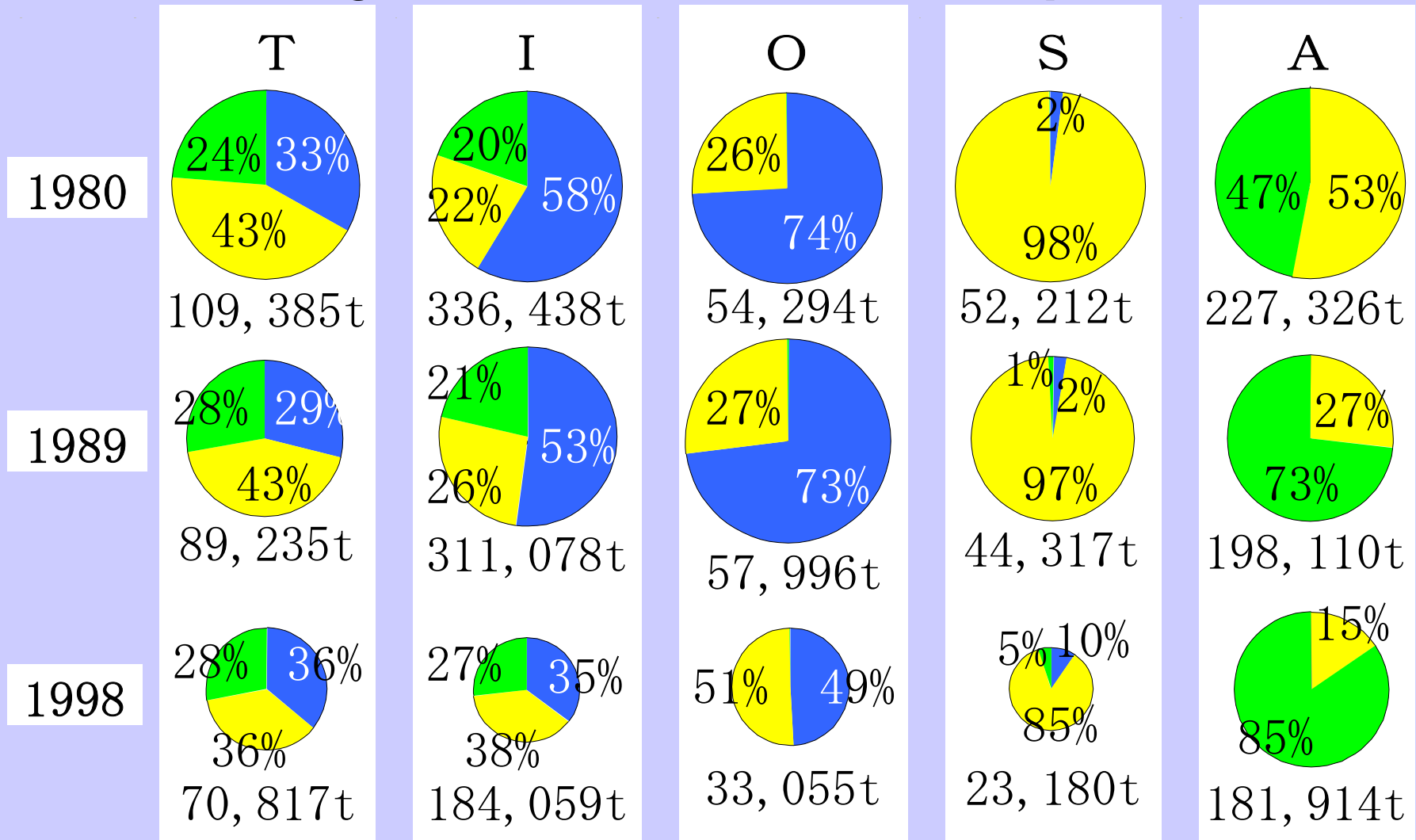
Data: Based on Ministry of Environment (2004)

② Monitoring of environment and living resources

- Fishing boats collect huge amount of oceanographic and meteorological data.**
- Fisheries statistics in particular of fish catch data in terms of weight according to species are valuable information of living resources.**
- No other similar data are available covering long term and wide area of the sea.**
- By the analysis of fish catch data, estimation of ecosystem change is possible.**

"Species Composition"

Fishery catch and the composition



■ : pelagic ■ : benthic ■ : seaweed

③ Purification of polluted environment through biological activities and food chain

- Filter feeder such as bivalves purify water and detritus feeder purify sediment.**
- Aquatic animals decompose organic matter indicating the reduction of COD value.**
- When organic matter in the area is carried out through food chain, it is understood as a kind of purification of the area.**

Filtering activities by bivalves (examples of estimation)

- 2000-3000 L/m²/day Tokyo Bay (Hosokawa et al., 1996)
 - 442 L/m²/day Tokyo Bay (N.R.I.E, 2001)
 - 1- 261 L/m²/day Tokyo Bay (Konuma et al., 2002)
 - 1322 L/m²/day Ariake Sea (Nakamura et al., 2003)
-
- 22.8 L/g/day Tokyo Bay (Hiwatari et al., 2002)
 - 1- 25 L/indiv./day Tokyo Bay (Konuma et al., 2003)

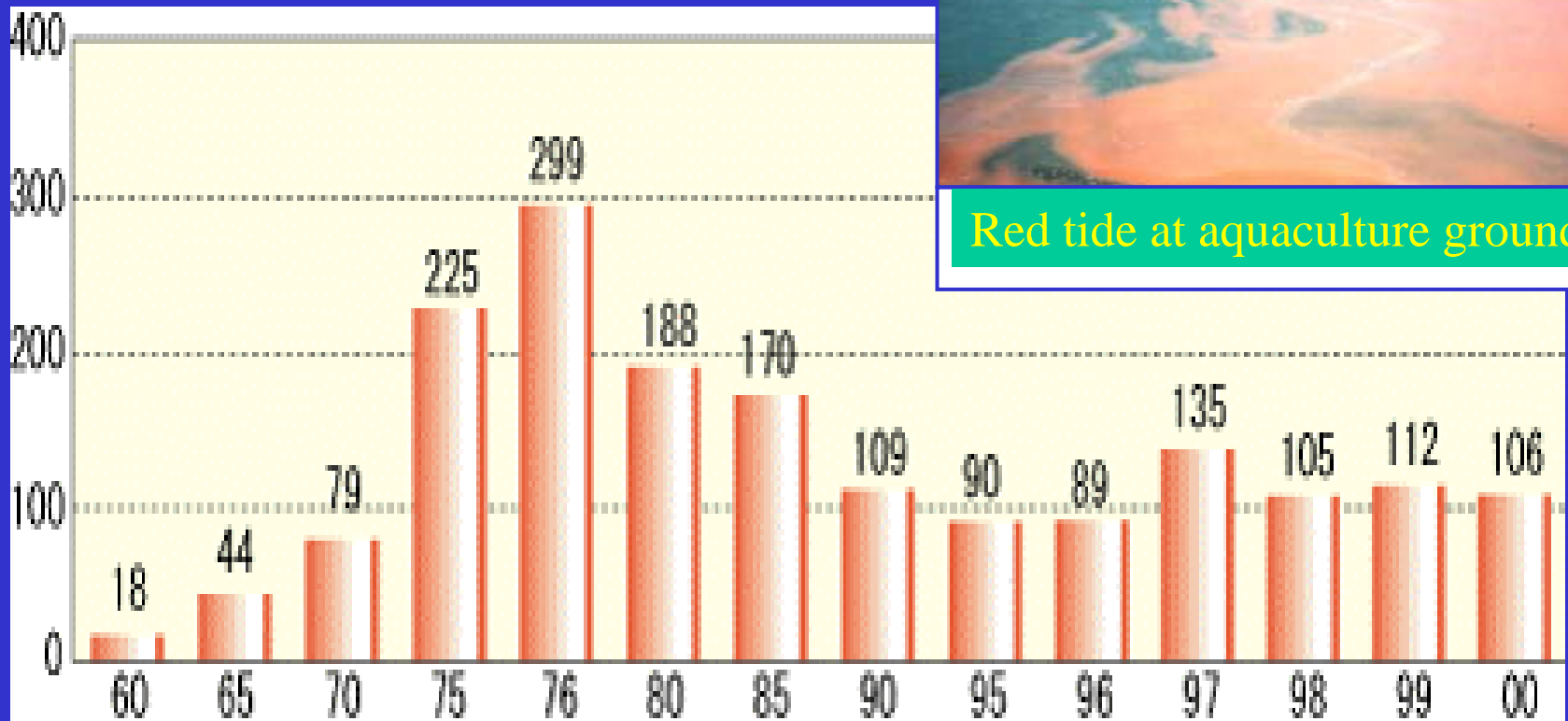


④ Environmental watching by fisherman

- Fisherman is a careful watchman of marine environment who finds out red tide, oil spill and any kind of abnormal condition.
- When fishing right of the area become null and void due to some reason, environment of the area often deteriorates because of the lack of watching.
- Networking of the information collected by fisherman can play an important role on environmental conservation.



Red tide at aquaculture ground

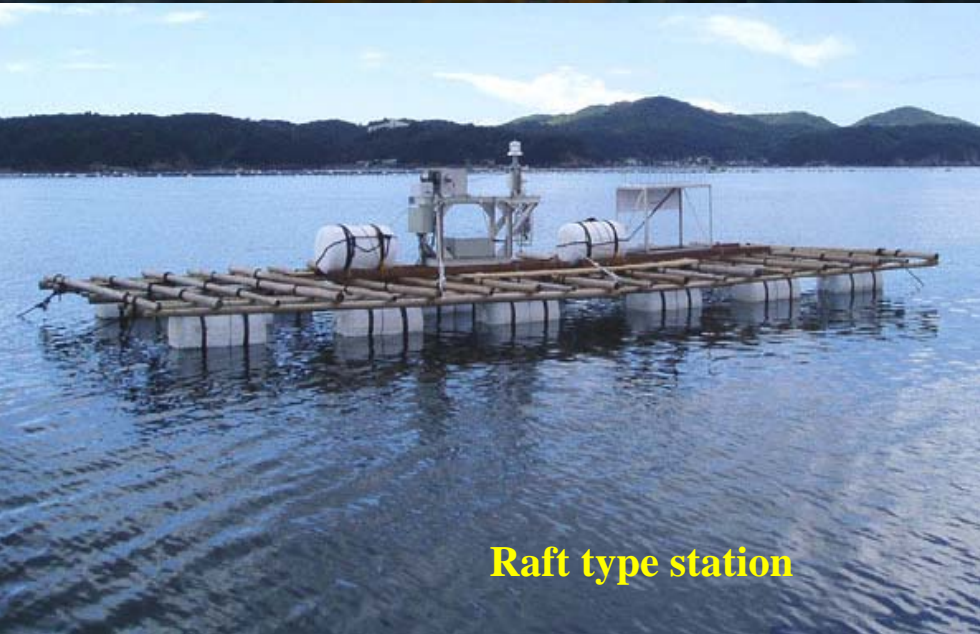


**Number of occurrence of red tide
observed in the Seto Inland Sea**

Automatic monitoring buoy in Ago Bay



Buoy type station



Raft type station

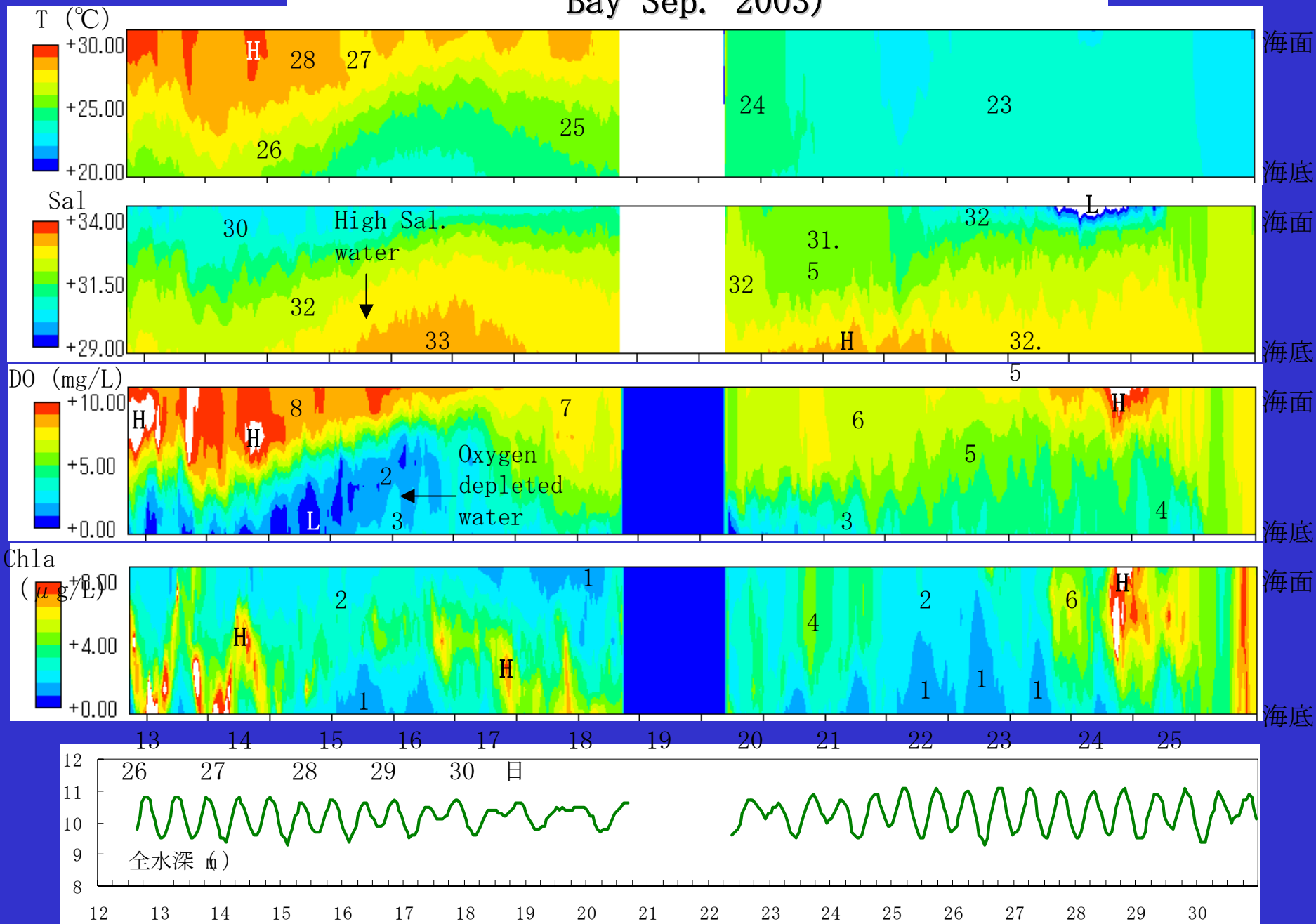


Solar battery



Observed water quality data are transmitted once in an hour with use of DOPA network

Observed monitoring data at Tategami (Ago Bay Sep. 2003)



⑤ Environmental education

- Fisheries and aquaculture provide us with valuable opportunity for environmental education and recreation.
- Fisheries ground and fisheries community are good site for eco-tourism.
- Fish market is a kind of active museum.
- Cooking fish can be an introductory anatomy and zoology.

Enhancement of clam shell resources was made as a part of environmental education of a primary school (Ago Bay)



Release of juvenile clam

Restoration of tidal flat

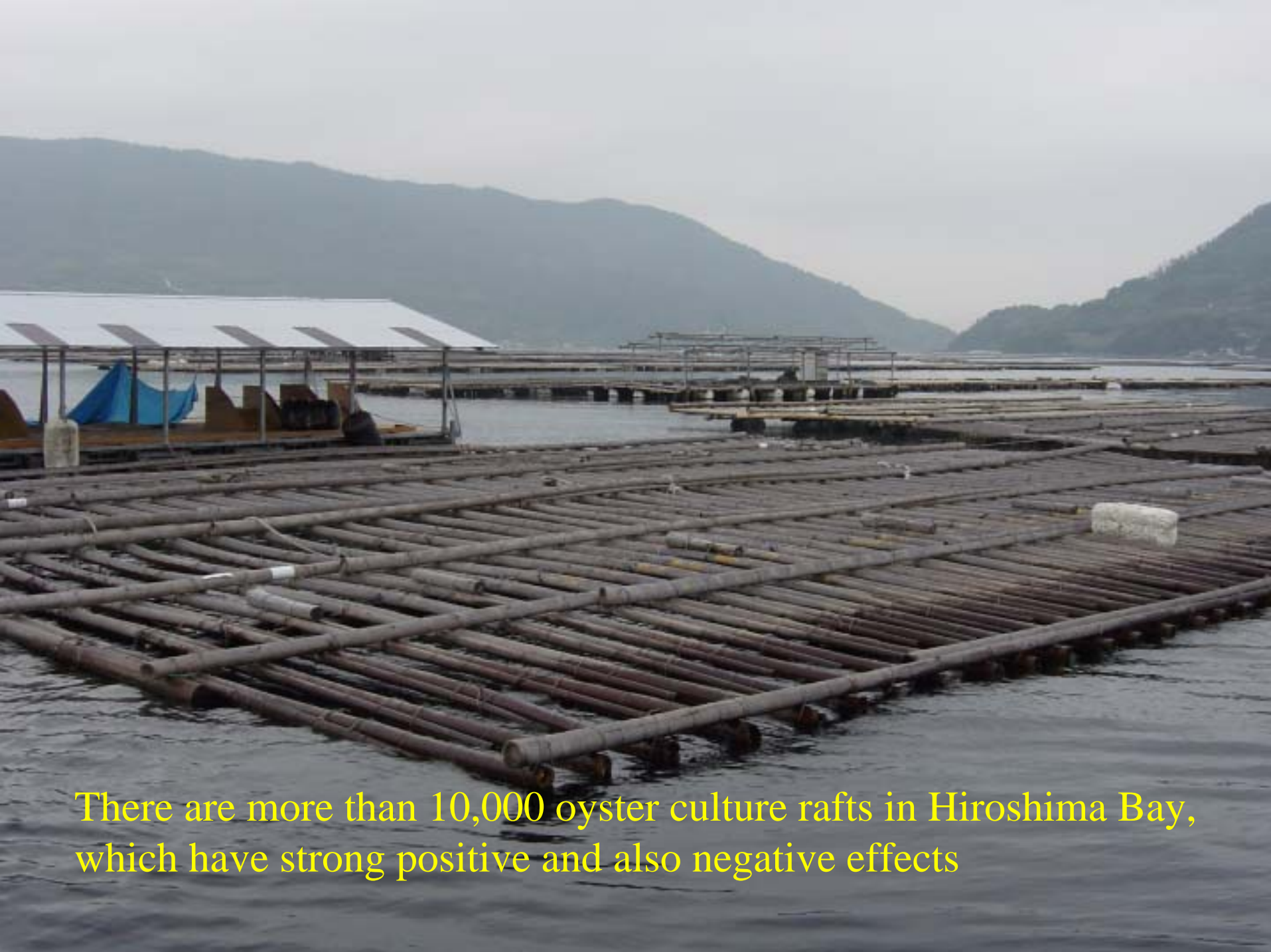


At a class room



**On integrated oyster culture management
in Hiroshima Bay, a main oyster culture
ground in Japan**





There are more than 10,000 oyster culture rafts in Hiroshima Bay, which have strong positive and also negative effects

水産・農業・工業…5機関連携



広島県が底層の環境改善やアマモ場の造成に向けた技術研究に乗り出す広島湾

広島湾の底層の環境改善やアマモ場の造成に向けた技術研究に乗り出す広島湾。県が水産、農業、工業、建設、環境の5機関と連携し、底層の貧酸素状態の改善やアマモ場の造成を目指す。研究では、底層の水をマゴやゴカイ、エビなど底生生物が生息している。しかし、上層の水温が上昇する夏場は海水が循環しにくく、底層付近で溶存酸素が欠乏する「貧酸素水塊」が発生。底生生物の生息を困難にしている。さらに泥などに蓄積されたアンモニアや硝酸を分解する細菌の活動が鈍り、赤潮の一因にもなっている。

広島湾の底層の環境改善やアマモ場の回復を目指す広島県は30日、実現に向けた技術研究に乗り出す方針を固めた。水産、工業技術、保健環境など分野の異なる県立五試験・研究機関が連携して、二〇〇四年度から三年がかりで技術を確立。本格的な環境再生事業につなげる。年明け早々、県研究開発推進本部(本部長・藤田雄山知事)を開設。県として初の試みを正式に決定する。

「貧酸素」改善へ

新年度から県

広島湾の再生本格研究

研究では、底層の水を

再び底層に戻す技術の開発を保健環境センターが担当。実用化に向けて水産試験場が、底生生物を指標に環境改善の状況を確かめる。

アマモ場の造成技術は、育苗システムの開発に農業技術センターと水産試験場が当たる。さらに、西部工業技術センターなどが人工衛星や無人ヘリを活用した上空写真による分布状況の把握▽農業技術センターなどがアマモ場の定着技術の開発▽林業技術センターが海が持つ生態機能を森林が果たす機

中国新聞

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クリック

貧酸素水塊 海中の酸素が底層に減る現象で、魚介類の生存を脅かすケースもある。植物性プランクトンの死がいな

と底底の有機物をバクテリアが分解する際、多量の酸素を消費するため発生。気温が上がる1〜9月、海水の上下の酸素がはがなくなり、底層でより深刻化する。

Integrated study on the restoration of Hiroshima Bay environment including Ohta River watershed area has just started



Reforestation activities in the upstream area of Ohta River were made by volunteer group as a part of integrated environmental management from hilltop to coastal area

New approach for integrated oyster culture in Hiroshima Bay (proposal)

To maximize positive effect:

**high quality oyster meat, purification and
material cycling, habitat, floating algal
bed, recreation, amenity, education**

To minimize negative effect:

**sediment deterioration, inhibition of tidal
current, PSP, waste from oyster culture**

Some related activities for integrated aquaculture management

- To minimize waste material**
- To reuse the waste material**
- To reduce energy consumption**
- To reduce new resource consumption**
- To restore deteriorated environment**
- To collaborate with variety of stakeholders**



Some parts of drift waste on the beach come from fisheries



Recycling use of pearl oyster shell for environmental restoration of tidal flat and seaweed bed is being made in Ago Bay

Future Direction for Integrated Aquaculture Management

- **To be sustainable and responsible**
- **To supply safe and clean food**
- **To enhance regional economy and employment**
- **To contribute to healthy material circulation and healthy ecosystem**
- **To collaborate with holistic regional management as a part of integrated coastal zone management including watershed area**
- **To maximize multi-functional roles of fisheries**